

REMARKS

Claims 1 through 5 and 7 through 63 are currently pending in the application.

Claims 33 through 57 are withdrawn from consideration in the Office Action as being directed to a non-elected invention.

Claims 1 through 5, 7 through 32 and 58 through 63 currently stand rejected.

35 U.S.C. § 112 Rejections

Claim 9 is rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. Applicant has amended the claimed invention to correct the deficiencies noted by the Examiner for the presently claimed invention to particularly point out and distinctly claim the subject matter of the invention to comply with the provisions of 35 U.S.C. § 112. Therefore, presently amended claim 9 is allowable under the provisions of 35 U.S.C. § 112.

35 U.S.C. § 102(e) Rejections

Claims 1, 2, 4, 5, 7, 10 through 12, 15, 22 and 58 through 60 were rejected under 35 U.S.C. § 102(e) as being anticipated by Dery et al. (U.S. Patent 6,074,895).

Applicant submits that a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.

Verdegaal Brothers v. Union Oil Co. of California, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Dery et al. describes a method of forming a flip-chip assembly. A flip-chip 110 with a passivation layer 111 of polyimide or other material is attached to a chip carrier 120 which may have an epoxy resin solder mask surface 124 with inorganic filler particles (see col. 3, lines 46-57 and col. 4, lines 11-15). A gaseous plasma is used to treat the chip 110 in order to oxidize and microroughen the surface of passivation layer 111 (see col. 4, lines 1-8). The surface 124 of chip

carrier 120 may also be roughened by the gaseous plasma or by mechanical means (see col. 4, lines 36-60). An encapsulant material 140 is then used to underfill the space between flip-chip 110 and chip carrier 120. The plasma treatment is believed to enhance adhesion between the filler and the chip surface and chip carrier (see col. 1, lines 21-34).

Independent claims 1, 10 and 58 of the present application recite an element of the invention calling for “applying a liquid wetting agent layer” to one of a semiconductor surface and a substrate surface. Applicant respectfully submits Dery et al. fails to expressly or inherently anticipate “applying a liquid wetting agent layer” under 35 U.S.C. § 102. Instead, Dery et al. uses a gaseous plasma to chemically and physically alter existing chip passivation layer 111 and chip carrier surface 124 to improve adhesion and reduce the incidence of delamination (see col. 2, lines 51-64). There is no discussion whatsoever of applying a layer of liquid wetting agent to any of the chip or substrate surfaces. Accordingly, Applicant respectfully submits claims 1, 10 and 58 are allowable over Derry et al. under 35 U.S.C. § 102(e). Claims 2, 4 through 7, 9, 11, 12, 15, 22, 59 and 60 are allowable, among other reasons, as depending from claims 1, 10 and 58.

Furthermore, Derry et al. fails to anticipate under 35 U.S.C. § 102 the claim 4 and claim 59 limitation “applying said liquid wetting agent layer comprises any one of a dispensing method, a brushing method, and a spraying method”, the claim 7 limitation “wherein said liquid wetting agent layer comprises a plurality of layers”, and the claim 9 limitation “applying said liquid wetting agent layer comprises providing a material for increasing the surface tension to one of said surface of said semiconductor device and said surface of said substrate”. Derry et al. simply modifies an existing passivation layer and a chip carrier surface. Neither the passivation layer nor the chip carrier surface of Dery are intended to function as liquid wetting agent layers. Any wetting agent properties are incidental to the primary purpose of the passivation layer and chip carrier surface.

35 U.S.C. § 103(a) Rejections

Rejection Based on U.S. Patent 6,074,895 to Dery et al. and further in view of U.S. Patent 4,231,910 to Plueddemann

Claims 3, 8 and 61 through 63 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Dery et al. as applied to claims 1, 2, 4, 5, 7, 10 through 12, 15, 22 and 58 through 60 and further in combination with Plueddemann (U.S. Patent 4,231,910). Applicant respectfully traverses this rejection as hereinafter set forth.

Applicant submits that to establish a *prima facie* case of obviousness under 35 U.S.C. § 103 three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Third, the cited prior art reference must teach or suggest all of the claim limitations. Furthermore, the suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on Applicant's disclosure.

Applicant respectfully submits this combination fails to establish a *prima facie* case of obviousness under 35 U.S.C. § 103.

Plueddemann teaches a primer composition for improving adhesion between a solid substrate and a thermoplastic. The composition consists essentially of 1 to 25 weight percent of an organosilicon compound selected from a group of silane compounds or partial hydrolyzates thereof and 75 to 99 weight percent of an alkoxyethyltriazine (see col. 2, lines 5-17). Plueddemann teaches an improved wet and dry adhesion of thermoplastics to solid substrates. (see col. 3, lines 22-24). The primer compound of Plueddemann is not directed to improved flow of an underfill material. There is nothing in the cited references or from the knowledge generally available in the art that would motivate one of ordinary skill to combine the teachings of Plueddemann with the invention of Dery et al.

Dery et al. is directed to semiconductor manufacturing, while Plueddemann is drawn to forming a specific chemical composition. Plueddemann makes no mention of applying the inventive composition to a semiconductor process such as that in Dery et al.

It was asserted in the Office Action that since both processes are drawn to improving adhesion of a plastic, it would be obvious to combine the two. However, "The mere fact that the prior art may be modified in the manner suggested in by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification. *In re Gordon*, 733 F.2d at 902, 221 USPQ at 1127" (Fed. Cir. 1984) (at 1783). There is nothing in either of the references to indicate using the composition of Plueddemann in place of, or in combination with, the gaseous plasma of Dery et al. would provide any desirable improvement. In fact, there is no reasonable expectation that this modification would be successful. Plueddemann teaches a composition for improving adhesion between a *solid substrate* and a *thermoplastic*. Plueddemann does not teach, suggest, or contemplate adhering a liquid underfill encapsulant or adhering to an epoxy resin solder mask such as those described in Dery et al. Dery et al relies on additional method steps to enhance adhesion. The plasma treatment of Dery et al. chemically modifies or roughens the surfaces to improve bonding. As a result, Dery et al. teaches away from a liquid wetting agent to enhance flow of the underfill material. In contrast, the liquid wetting agent of Applicant's invention does not interact with the surfaces to be bonded and does not alter the surface of either the chip or the substrate. Neither Dery et al. nor Plueddemann shows use of a chemical compound to enhance flow of underfill material. At best, the combination would be obvious to try, which does not fulfill the standards for establishing a *prima facie* case for an obviousness under 35 U.S.C. § 103. Applicant therefore respectfully submits the combination is an attempt to piece together the subject matter required by the claims which could only be motivated by the benefit of hindsight provided solely by Applicant's own disclosure.

Additionally, the presently claimed limitation of "a liquid wetting agent" found in claims 3, 8, 61, and 63 is not taught or suggested by either Dery et al. or Plueddemann. Therefore, the

cited prior art references do not teach or suggest all of the claim limitations of claims 3, 8, 61 and 63.

Accordingly, Applicant respectfully submits a *prima facie* case of obviousness has not been established, and claims 3, 8, 61, 62 and 63 are allowable under 35 U.S.C. § 103(a).

Rejection Based on U.S. Patent 6,074,895 to Dery et al. and further in view of U.S. Patent 5,766,982 to Akram et al.

Claims 13, 14, 16 through 21 and 23 through 30 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Dery et al. as applied to claims 1, 2, 4, 5, 7, 10 through 12, 15, 22 and 58 through 60 supra, and further in combination with Akram et al. (U.S. Patent 5,766,982). Applicant respectfully traverses this rejection as hereinafter set forth.

The discussion of Dery et al. above is incorporated herein by reference. Akram et al. teaches an apparatus and method for underfilling an area between a semiconductor substrate 10 and a flip-chip 12 (see col. 2, lines 52-54). Akram teaches that underfilling may be accomplished by filling from an opening 60 near the center of substrate 10, while the substrate and semiconductor assembly is inclined, and with the assistance of a vibrating device 48 (see col. 2, lines 60-64, col. 5, lines 56-67 and col. 6, lines 34-61).

There is no motivation to combine the teachings of Dery et al. with Akram et al. to establish a *prima facie* case of obviousness under 35 U.S.C. § 103 because the references teach away from one another. Akram et al. advocates a method which is cost effective and utilizes standard substrates (see col. 2, lines 46-49). Further, Akram et al. teaches away from underfilling processes that require additional equipment or specialized substrates (see col. 2, lines 32-42). Dery et al., on the other hand, teaches that the passivation layer 111 and substrate surface 124, must be chemically and physically modified with a gaseous plasma. Additional equipment and additional steps are required in order to achieve the process of Dery. Therefore, Dery et al. requires a plasma chamber (see col. 1, lines 57-63). Applicant respectfully submits that it "is improper to combine references where the references teach away from their combination."

M.P.E.P. §2145(X)(D)(2) (citing *In re Grasselli*, 713 F.2d 731, 743, 218 U.S.P.Q. 769, 779 (Fed. Cir. 1983)).

Additionally, the methods of Akram rely on mechanical means such as applying underfill material through a centrally located opening, tilting the substrate and chip assembly to use gravitational forces, and vibrating the substrate and chip assembly to enhance the flow of underfill material and capillary action. In contrast, Applicant's presently claimed invention relies upon the use of a chemical agent to enhance capillary action and flow of underfill material. Neither Dery et al. nor Akram et al. teaches or suggests enhancing capillary action and flow of underfill material based on a chemical compound.

The cited references, alone or in combination, also fail to teach or suggest all of the claim limitations to establish a *prima facie* case of obviousness under 35 U.S.C. § 103. As discussed above, Dery et al. does not teach the limitation of "applying a liquid wetting agent layer" recited in independent claims 1 and 10. Instead, Dery et al. uses a gaseous plasma to chemically and physically alter the existing chip passivation layer and chip carrier surface. Akram et al. does not involve any kind of wetting or adhesion improvement, and its combination with Dery et al. does not overcome the deficient limitation of "applying a liquid wetting agent layer". Claims 13, 14, 16 through 21 and 23 through 30 depend from independent claims 1 and 10. If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988).

Accordingly, Applicant respectfully submits the cited references fail to establish a *prima facie* case of obviousness, and claims 13, 14, 16 through 21 and 23 through 30 are allowable under 35 U.S.C. § 103(a).

Rejection Based on U.S. Patent 6,074,895 to Dery et al. and further in view of U.S. Patent 5,203,076 to Banerji et al.

Claims 31 and 32 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Dery et al. as applied to claims 1, 2, 4, 5, 7, 10 through 12, 15, 22 and 58 through 60 supra, and

further in view of Banerji et al. (U.S. Patent 5,203,076). Applicant respectfully traverses this rejection as hereinafter set forth.

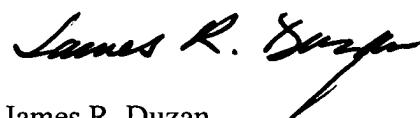
The discussion of Dery above is incorporated herein by reference. Banerji teaches or suggests mechanical means to reduce voids, improve flow of underfill material and enhance capillary action. The means include: applying a vacuum (col. 2, lines 49-54), using air to force the polymer infiltrant into the underchip area (col. 2, lines 57-60), and carrying out the above steps over a hot plate to reduce the viscosity of the polymer infiltrant so that it flows more readily. (col. 2, lines 60-63). Neither Dery nor Banerji teaches or suggests enhanced capillary action and flow of underfill material based on a chemical compound.

Claims 31 and 32 depend from independent claim 10 which recites the limitation of "applying a liquid wetting agent layer". For the same reasons as described above, neither Dery et al. nor Banjeri et al. teach or suggest this claim limitation. Claims 31 and 32 are therefore allowable under 35 U.S.C. § 103(a), among other reasons, as depending from claim 10.

Applicant submits that claims 1 through 5, 7 through 32 and 58 through 63 are clearly allowable over the cited prior art for the reasons set forth hereinabove.

Applicant requests the allowance of claims 1 through 5, 7 through 32, and 58 through 63 and the case passed for issue.

Respectfully submitted,



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